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IV. Remarks

Claims 1 through 20 are pending in the application. Claims 1, 9 and 15 have been amended. No new claims have been added.

The Examiner sought certain corrections regarding abbreviations in Paragraph [0058]. Such corrections have been attended to. Applicants' attorney has also undertaken corrections of a minor, housekeeping nature to Paragraphs [0049] and [0053].

Rejections Under 35 USC § 103

Claims 1 through 2, 5, 7 and 9 through 20 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,131,054 issued to Shibahata (Shibahata) in view of U.S. Patent No. 5,742,917 issued to Matsuno (Matsuno).

Shibahata discloses a mechanical and electronic yaw moment control system for a vehicle which computes longitudinal acceleration and senses lateral acceleration, then computes a corrected longitudinal and lateral acceleration value based upon the sum of primary and tertiary terms multiplied by constants. Depending upon whether the vehicle is front wheel drive or rear wheel drive, respectively, these primary and tertiary terms are added together (Figures 5A and 5B) or subtracted from one another (Figures 8A and 8B). According to the Summary of the Invention, understeer can be corrected only in a front wheel drive vehicle (Embodiments 1 and 2) and oversteer can be corrected in only a rear wheel drive vehicle (Embodiments 3 and 4).

Shibahata includes sensors for wheel speed, steering angle and lateral and/or longitudinal acceleration. While other yaw control systems utilize similar sensor arrays, the mechanical components they ultimately control more vis bly define and

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highlight the differences between the systems. In Shibahata, the controlled axle, either a rear axle in a front wheel drive vehicle (Figure 1) or a front axle in a rear wheel drive vehicle (Figure 7) is passive, that is, no torque is delivered to the axle assembly from the vehicle prime mover or driveline. The controlled Shibahata axle defines merely a pair of clutches (3r and 3l) which, associated with two gear sets, engage to drive one associated wheel faster than the other or vice versa. Thus, torque cannot be added or injected into the controlled axle but merely transferred from side to side.

Matsuno teaches a driving torque distribution system for a motor vehicle wherein an array of sensors including an engine speed sensor, accelerator pedal position sensor, gear position sensor, steering angle sensor, vehicle speed sensor and yaw rate sensor are utilized to, inter alia, estimate the friction coefficient of the road surface in real time. The driving force is then controlled according to the estimated friction coefficient. As noted in column 5, this disclosure is based upon the idea that it is possible to estimate the friction coefficient of a road surface by treating the lowering of tire lateral force as the lowering of cornering power. In turn, the cornering power can be obtained from the steering angle, vehicle speed and the actual yaw rate.

Once again, it is both instructive and necessary to understand the type of mechanical system and components that the electronic system is controlling. As illustrated in Figure 2, the Matsuno system includes a center differential 20, the differentiation of which may be controlled or inhibited by a center hydraulic clutch 27. In conventional fashion, the center differential 20 includes primary and secondary outputs to a front differential 7 and associated wheels as well as a rear differential 11

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and associated wheels. The rear differential 11 also includes a rear hydraulic clutch 28 which controls and inhibits differentiation of the rear differential 11. Thus, the controlled center differential clutch 27 of Matsuno is only able to permit or inhibit differentiation and drive the primary and secondary driveline speeds toward one another or into synchronism when it is engaged just as the controlled rear differential clutch 28 is only able to drive the rear axle speeds toward one another or synchronize them.

In both Shibahata and Matsuno, these mechanical configurations and limitations affect upstream activities and determine the computational parameters and outputs of the microprocessor or control unit.

As Figure 1 and particularly Figure 2, render manifest, Applicants' mechanical system is clearly distinct from both Shibahata and Matsuno. Applicants' controlled device is a motor vehicle rear axle, which is, first of all, driven directly from the output of a transaxle without the use of a center differential and second of all, without the use of a differential, such as a conventional, caged differential, in the rear axle. This is possible because the rear axle consists essentially of a bevel gear input which commonly drives a pair of (left and right) independently engageable friction clutches. When the clutches are disengaged, no drive torque is transferred to the respective axles and tire and wheel assemblies and the axle's free wheel. The clutches may be independently engaged to deliver drive torque to the associated rear wheels as desired up to full engagement of both clutches in which condition drive torque delivered to the input of the rear axle is split evenly between the two rear wheels.

These mechanical distinctions between Shibahata and Matsuno on the one hand and Applicants' device on the other are significant because in both the cited

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systems axle clutch control actions (manifested by clutch engagement) always affect both left and right wheels. That is, with the axle clutches of Shibahata and Matsuno, assuming there is a wheel speed difference, clutch engagement will always slow the faster wheel and speed the slower wheel. If there is no speed difference, of course, engagement of the clutch will not change matters. The same is true of the center differential of Matsuno: with a front to rear speed difference, clutch engagement can only slow the faster driveline and speed the slower driveline.

In view of the foregoing, independent claims 1, 9 and 15 have been amended to clearly recite the rear axle configuration as having an input adapted to receive drive torque and that the input drives a pair of independently operable clutches which are adapted to drive a respective rear axle or wheels. This limitation is manifestly distinct and patentably distinguishes Applicants' claims over Shibahata and Matsuno.

As noted above, such mechanical distinctions influence the manner in which data is utilized to provide control signals. For example, Shibahata, as illustrated in Figure 2, utilizes engine speed and gear position to generate a longitudinal acceleration signal, senses lateral acceleration, then provides corrected longitudinal and lateral acceleration values through the utilization of equations which sum primary and tertiary terms including positive constants. At no time does the system detect or compute understeer or oversteer values.

Matsuno, as noted above, utilizes similar input sensors such as an engine speed sensor, an accelerator pedal sensor, a gear position sensor, a steering angle sensor, a vehicle speed sensor and a yaw rate sensor to determine, as also noted above, an estimated friction coefficient of the road surface by considering the lowering tire lateral force as the lowering of cornering power whose value can be

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obtained from the steering angle, vehicle speed and actual yaw rate. Once again, nothing in Matsuno deals with the detecting and determination of oversteer or understeer. Rather, Matsuno attempts to estimate in real time the friction coefficient of the road surface.

By way of contrast, Applicants' controller utilizes signals from a yaw rate sensor, a lateral acceleration sensor, a throttle position sensor, four wheel speed sensors and a steering angle sensor. The wheel speeds, throttle position and steering angle are utilized by left and right traction controller modules to provide torque signals to an arbitrator module which also receives a signal from a dynamics controller which also receives signals regarding the yaw rate and the turn speed condition. Left and right understeer and oversteer subroutines are executed and flags are set to activate the smart actuator circuit to energize the rear axle clutches at the desired torque level. This sequence of operation is nowhere taught in Shibahata or Matsuno.

As amended and for at least the foregoing reasons, it is submitted that claims 1, 2, 5, 7 and 9 through 20 are patentable over Shibahata in view of Matsuno.

Claims 2 through 4 were rejected under 35 USC §103(a) as being unpatentable over Shibahata and Matsuno as applied to claim 1, in view of U.S. Patent No. 5,845,546 issued to Knowles et al. (Knowles).

The Shibahata and Matsuno have been discussed and distinguished above, such text is hereby incorporated.

Knowles discloses a twin clutch rear axle of the type disclosed by Applicants. The rejection, however, is not well taken. For this rejection to be viable under 35 U.S.C. §103(a), the references must somewhere or in some manner suggest their

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combination or modification. As discussed above, Shibahata teaches a non-driven axle with parallel clutches arranged with inverse gear trains. Nothing here suggests the use of a driven axle assembly with two independent, directly coupled clutches. Likewise, Matsuno utilizes a conventional caged differential having a clutch across two of its elements which selectively inhibits differentiation. Both this structure and function are remote and distinct from the teaching of Knowles. The combination or modification of either Shibahata or Matsuno by Knowles appears to be highly problematical and likely only encouraged by Applicants' disclosure.

Furthermore, it should be recalled that, as discussed above, the mechanical, controlled components dictate the computational and data processing schemes such that all components create an integrated system. Thus, substituting the twin clutch axle of Knowles into either Shibahata or Matsuno and driving it with the electronic signals of their controllers would result in a remarkably inoperative system. For at least the foregoing reasons, claims 2 through 4 recite patentable subject matter under a proper interpretation of 35 U.S.C. §103 and should be allowed.

Claims 6 and 8 were rejected under 35 USC §103(a) as being unpatentable over Shibahata and Matsuno as applied to claim 1, in view of U.S. Patent No. 5,029,660 issued to Raad et al. (Raad).

Shibahata and Matsuno have been discussed above and such discussion is hereby incorporated by reference. Raad teaches a steering control method and system for vehicles. The system utilizes both a PWM controller as well as a proportional integral derivative controller in the control block 78. The Examiner asserts:

It would have been obvious to one of ordinary skill at the time of the invention to modify the apparatus for controlling yaw in a motor

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vehicle of Shibahata and Matsuno as applied to claim 1, to include a steering control system and method ...as taught by Raad et al. to accurately control steering assist levels under a wide variety of system operating conditions.

While this may be true, Applicants' disclosure and claims in no way are related to controlling steering assist levels under a wide variety of operating conditions. Rather, Applicants are controlling the application of torque to the rear wheels of a front wheel drive vehicle to improve vehicle handling characteristics by addressing understeer and oversteer. Raad therefore appears to have little relevance. Furthermore, it appears to lack any suggestion regarding its combination or modification with vehicle driveline based yaw control systems. The citation of this reference, as well, appears to have been prompted by Applicants' own disclosure. It is submitted that claims 6 and 8 are patentable under a proper interpretation of 35 U.S.C. §103.

Finally, the several references cited by not applied by the Examiner have been reviewed and found to be less relevant than those references cited and applied. Accordingly, further study and comment regarding these references will be deferred until such time that their increased relevance becomes apparent.

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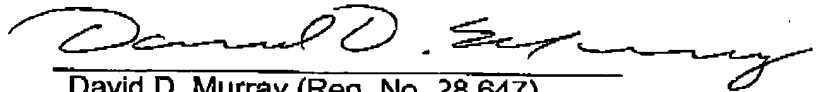
SUMMARY

Pending Claims 1 through 20 as amended are patentable. Applicants respectfully request the Examiner grant early allowance of these claims. The Examiner is invited to contact the undersigned attorneys for the Applicants via telephone if such communication would expedite this application.

Respectfully submitted,

January 24, 2005

Date



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Attachment: Replacement Sheet(s) of Drawings